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The role of histology in forensic autopsies. Is a histological examination always necessary to determine a cause of death?

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ABSTRACT

In England and Wales there is a conflict between the law and advice from regulatory bodies in relation to the sampling of human tissue for histological examination following medico-legal post-mortem examinations. Considering the results of previous publications, we performed a specific study to investigate the role of histology in determining the cause of death in cases at a forensic unit. A retrospective study of 500 adult forensic cases was performed. Cases were categorised by the role the histological examination played in determining a cause of death and its contributory factors. Furthermore, cause of death, manner of death, organ systems involved and discrepancies were assessed. Of the 500 cases, histology was undertaken in 287 cases (58%). Microscopic examination provided the cause of death in 2% of cases where histology had been undertaken, and it added to the cause of death in 8%. In 61% of cases microscopy confirmed the macroscopic findings, and in 30% it did not influence the medical cause of death. Histological examination of all organs in all forensic cases for the purpose of providing a medical cause of death is not supported. Practice guidance should be adjusted to reflect that, whilst histological examination is essential in certain circumstances, the decision to retain material for histology should be made on a case by case basis at the pathologist's discretion.

INTRODUCTION

Most post-mortem examinations performed in England and Wales are medico-legal autopsies conducted under the authority of Her Majesty's Coroner. The purpose of these autopsies is to assist HM Coroner with answering four basic questions in relation to the deceased individual: *who* the person was and *when, where* and *by what means* they came by their death. In England and Wales these medico-legal post-mortem examinations are traditionally split into two categories: so-called "routine" coronial autopsies (i.e. non-forensic) and "forensic" cases encompassing those deaths of interest to the police (i.e. suspicious or homicide deaths).

In England and Wales, The Coroners Rules 1984[1], later amended in 2005[2], place strict limitations on the retention of material from medico-legal post-mortem examinations. When performing a post-mortem examination under the authority of HM Coroner, pathologists are authorized to retain only that material which 'bears upon the cause of death' or 'the identification of the deceased'. In contrast, general guidelines from The Royal College of Pathologists (RCPath) relating to both "non-forensic" and "forensic" post-mortem examinations, advise the pathologist to undertake a histological examination of all major organs in all cases[3]. The 'Code of Practice and Performance Standards for Forensic Pathology in England, Wales and Northern Ireland', the professional standard to which all pathologists registered on the Home Secretary's Register of Forensic Pathologists must adhere to, goes further despite said coronial legislation, by informing the forensic pathologist that:

'A histological examination should be made, by the pathologist himself, of the major organs (assuming that they are not heavily decomposed) in all cases. Histology is of value in confirming, evaluating and sometimes revising the course of natural disease processes that may have contributed to the cause of the death. Other samples should be taken for histological examination depending on the circumstances of the case, e.g. for the purposes of ageing injuries. The reasons behind any decision not to undertake a histological examination must be adequately recorded, in order that the pathologist may be in a position to defend this decision if required'[4].

This document does not define the meaning of the words 'major organs', nor does it inform the user as to the extent of sampling of any organ undertaken. This is left to the discretion of the pathologist.

Within the peer-reviewed literature, the usefulness and cost-effectiveness of retaining tissue for post-mortem histology has been discussed with research published for both hospital and medico-legal forensic post-mortem examinations[5-20]. Previous studies have shown that histological analysis has a major impact on previously made diagnoses in hospital autopsies[6-8]. However, published studies concerning the use of routine histological examination in forensic post-mortem examinations are contradictory[9-12]. Langlois *et al* found that histology provided,

altered or confirmed the cause of death in 53% of the cases, providing the cause of death in 7.7% of their cases[9]. De la Grandmaison *et al* found the cause of death was established only after histological examination in 8.4% of cases[10] and Molina *et al* found that microscopic examination affected the cause of death in only 1 case of the 189 cases studied (0.5%)[11]. These figures would appear to suggest that histological examination is pivotal in determining the cause of death in a minority of cases and of assistance in only half. A policy of histological sampling in all cases has implications in terms of costs and the legal requirements related to tissue storage, use and disposal[21]. In the March 2012 issue of Forensic Science, Medicine and Pathology (FSMP) the case for and against routine histology in forensic practice was discussed. In 8 commentaries provided by forensic pathologists from different countries the opinions were found to differ from undertaking routine histology of the major organs in all cases to a selective histological sampling[13-20]. In view of the conflicting law and advice from regulatory bodies, and that the previous studies have not reflected the mix of cases undertaken by a forensic pathology unit in England and Wales, we felt the need to study further the role of histology in relation to determining the cause of death in forensic post-mortem examinations.

MATERIALS AND METHODS

We undertook a retrospective review of forensic cases performed at the East Midlands Forensic Pathology Unit, Leicester, United Kingdom (UK). Consecutive case files were retrieved from the archive and reviewed. Only adult cases (i.e. aged 18 years and over) were included as it was considered that a histological examination was required in all paediatric cases. Similarly, cases of inflicted head trauma were also excluded as it was considered that a neuropathological examination with histology was necessary in all such cases. Cases involving skeletal remains were also excluded, as no organs were available for histological analysis. The data collection process was stopped once an arbitrary target of 500 cases had been reached. The reports were reviewed by a visiting pathologist to the Unit (i.e. a person who was independent to the Unit, and whom had not been involved in any of the post-mortem examinations). In every case the following data were obtained: age, gender, histology performed (yes/no), role of histology, main organ system in which the fatal pathology was located, cause of death and manner of death. Any discrepancy between macroscopic and microscopic findings was noted. The microscopic sections were not reviewed.

RESULTS AND DISCUSSION

The 500 cases reviewed covered a time period from the 31th of December 2011 going back to the 14th of November 2008. The mean age of the population studied was 49 years, consisting of 343 males and 157 females.

The percentages reported below are rounded up to one decimal place of accuracy and therefore any perceived inconsistencies in relation to the results are attributed to a rounding error.

The manner and cause of death were categorized in accordance with the previous published work by Molina *et al* (Tables 1 and 2). In addition to the categories provided by Molina *et al*, we added the category 'traffic' to the manner of death and 'vehicle related' to the cause of death. Cases in which the manner of death could not be determined from the post-mortem examination were classified as 'undetermined'. Road traffic related deaths made up the largest proportion of cases (28%), followed by 'natural' deaths (23%) and then 'undetermined' (19%). The most frequent causes of death were again vehicle related (29%), followed by sharp force trauma (12%), intoxication (11%) and asphyxia (10%). The discrepancy between the percentages for the 'traffic' manner of death and 'vehicle related' cause of death can be accounted for by 5 cases consisting of aircraft crash related fatalities in which the manner of death could be determined as accidental, and a case where an individual was witnessed to exit a moving car, which was considered 'undetermined' as the individual's motivation could not be ascertained.

Table 1. Manner of Death

Manner of Death	No. of Cases	% of Cases
Natural	113	23
Homicide	65	13
Suicide	60	12
Traffic	142	28
Complication of medical intervention	7	1
Accident*	18	4
Undetermined	95	19
Total	500	100

* Defined as an incident that happens unexpectedly and unintentionally

Table 2. Cause of Death

Cause of Death	No. of Cases	% of Cases
Cardiac	55	11
Pneumonia	16	3
Blunt force trauma	7	1
Sharp force trauma	61	12
Vehicle related	147	29
Gunshot wounds	9	2
Intoxication[§]	54	11
Asphyxia	48	10
Drowning	6	1
Fall from height	10	2
Other natural	45	9
Other non-natural[±]	26	5
Unascertained	16	3
Total	500	99^

[§] Includes carbon monoxide poisoning
[±] Includes smoke inhalation
^ Not 100%, due to rounding error

The organ system in which the fatal pathology was present was most often the central nervous system (34%), followed by the cardiovascular system (26%). In 22% of the cases, fatal pathologies were present in multiple organ systems or it was not possible to attribute the fatal lesion to a specific anatomical organ system (for example in cases with a purely toxicological cause of death).

Human tissue had been retained for histological examination in 287 cases (58%). Tissue was not retained in those cases where the pathologist felt a cause of death could be provided on macroscopic examination alone. In these cases there would be no legal authority from HM Coroner to retain the tissue. In cases involving a police investigation, the decision not to retain tissue was made jointly with the investigating police officers after ensuring that they did not require the tissue to be retained for any other purpose. When histology is retained by the unit pathologists this usually involves sampling of the brain, heart (right and left ventricles and when indicated the coronary arteries and atrial ventricular node), right and left lung, liver, spleen and right and left kidneys. Additional organ sampling for example the pancreas, adrenals and pituitary gland is undertaken when the case requires this. The tissue is examined with traditional histochemical stains depending upon the pathology present. The use of immunohistochemistry for wound dating is available to the pathologists but is infrequently used as this approach is not routinely used to the authors' knowledge within the UK.

All cases were subjected to so-called 'critical checking', a mandatory form of internal audit required by the Home Office to be undertaken on all autopsy reports produced by Home

Office pathologists. The absence of histopathology did not affect this process in any case. The absence of a histological examination did not affect any of the case examinations and had, to our knowledge (by virtue of no court or police related feedback), no effect on any subsequent coroner or criminal court procedures. As it is normal for homicide cases to undergo a second autopsy in England and Wales, at no case was the lack of histology questioned with the original pathologist by the external defence pathologist. It is also unusual in our experience, when histology has been undertaken, for the defence pathologist to request to have sight of the material in their consideration of the case.

In 5 of the total 287 cases (2%) the histological examination alone provided the cause of death. Of these 5 cases, 2 concerned road traffic collisions where the injuries found at macroscopical examination were not sufficient to explain the death. Microscopic examination revealed respectively diffuse traumatic axonal injury and fat emboli to be the cause of death. These diagnoses cannot be made without histological examination, even if suspected from the macroscopic findings. The 3 other instances where histological examination provided the cause of death were diverse. In the first case a person was found to have pulmonary hypertension, which was diagnosed by histology solely. In the second case a giant cell myocarditis was the cause of death, also only diagnosed at microscopic examination. The third case consisted of a person who developed septicaemia with a T-cell lymphoma, which was diagnosed on histological examination. Our findings are not dissimilar to the findings of both Molina *et al*[11], who found that a microscopic examination changed the cause of death in less than 1% of the cases, and Langlois *et al*[9] who found that a histological examination resulted in a significant change in the diagnosis in 4.8%[9]. De la Grandmaison *et al*[10] found a higher percentage of 8.4% in which cause of death was established by histology alone. Slight differences between studies are to be expected due to the varying case mix between centres, and our quoted percentages do not take into account that in 42% of cases histological examination was not authorised due to a definite cause of death already being identified on macroscopic examination. What can be said is that all of these studies show that it is only a small percentage of cases in which histology is necessary to provide a cause of death.

In our study, a microscopic examination added to the medical cause of death in 8% of the 287 cases. Examples of those cases are vacuolation of the pancreatic cells microscopically seen in cases suspected of hypothermia as the cause of death at autopsy, a cerebro-vascular accident (CVA) as the cause of death which microscopically showed a amyloid angiopathy as contributing factor and a person who died of a combination of a larynx carcinoma and a pneumonia, the latter only seen microscopically. In 61% microscopy confirmed the diagnosis made by gross examination and in 30% it played no part in the determination of the cause of death. Langlois *et al*[9] defined the histological examination as 'contributory' to the post-mortem examination if it provided, altered or confirmed the cause of death[9]. If we consider that out of our total case selection of 500 cases, histology provided, altered or confirmed the

cause of death in 203 cases, this works out as a total percentage of 41%. This is not totally dissimilar to Langlois *et al*[9], who concluded that in 53% of cases histology was in some way 'contributory'.

In 16% of the 287 cases in which histology samples were retained, discrepancies were identified between the macroscopic and microscopic findings. Of these, the large majority consisted of minor discrepancies of which the most common was the presence of a mild degree of hepatic steatosis, seen microscopically but not described macroscopically. Other examples of minor discrepancies are a subcutaneous nodule macroscopically assessed as a lymph node, in which microscopy showed an epidermal cyst and a change in the degree of atheroma of the coronary arteries from no atheroma (macroscopically) to minimal atheroma (microscopically). In the 3% of cases in which there was a major discrepancy, there were 4 cases of pneumonia that had not been identified macroscopically. The other cases consisted of 1 case of pulmonary metastases which were seen only microscopically, 1 case where a thromboembolus in one of the pulmonary arteries was misdiagnosed macroscopically, 1 case where hemangiomas of the lip had been considered macroscopically to resemble bruises left by the process of smothering and 1 case where the degree of coronary artery stenosis by atheroma was estimated macroscopically as a maximum of 20% whereas histologically the stenosis was shown to be up to 90%. With the exception of the haemangiomas, these discrepancies did not influence the given medical cause of death or outcome of the post-mortem examination.

It has been put forward that histology has a role in the training of future forensic pathologists. We do not dispute this. Although it could be argued that the reduced sampling for histology could affect forensic pathology training this is not our experience. In the UK, prior to entering training in forensic pathology all trainees must gain a grounding in diagnostic histopathology and cytology. On entering forensic training the histology training concentrates on that related to medico-legal autopsy practice, rather than hospital diagnostic pathology. Despite our institute not undertaking histology on all cases, it is our experience as one of the four Home Office training centres that this has not compromised the delivery of training or the trainees' ability to pass their professional exit examinations (which include a histology exam) or undertake the full diagnostic service of a consultant forensic pathologist on graduation.

SUMMARY

This study, and work previously published by others, provides evidence that a histological examination is not crucial for determination of the cause of death in all forensic post-mortem examinations. The necessity to sample all organs in all cases is also questioned. In England and Wales, there remains a conflict for the forensic pathologist between the legal authority to

retain tissue for microscopic examination and codes of practice for medico-legal investigation of death. The potential risk of acting unlawfully whilst adhering to codes of practice (or vice versa) needs to be removed. We suggest that, for the UK, a wider audit of the role of a histological examination in forensic examinations should be undertaken. Ideally this would involve as many of the forensic units as possible, thus covering a wider range of types of death and a larger study population. It is hoped that this would enable the production of more evidence-based guidelines. Whilst stressing the importance of histological examination for the right clinical indications, we believe the decision to retain material should be made at the pathologist's discretion (in agreement with HM Coroner and the investigating police) on a case by case basis rather than the current guidance to sample all organs in every case regardless of its nature.

REFERENCES

1. The Coroners Rules 1984. http://www.legislation.gov.uk/uksi/1984/552/contents/made (last visited June 2013)
2. The Coroners (Amendment) Rules 2005 9(1). (SI 2005/420)
3. Guidelines on autopsy practice. The Royal College of Pathologists, London 2002.
4. Code of practice and performance standards for forensic pathology in England, Wales and Northern Ireland. Oct 2012. http://www.rcpath.org/Resources/RCPath/Migrated%20Resources/Documents/G/G131_CoPForensicPathology_Oct12.pdf (last visited June 2013)
5. Reid W. Cost effectiveness of routine postmortem histology. J Clin Path. 1987;40:459–461.
6. Bernardi F, Saldiva P, Mauad T. Histological examination has a major impact on macroscopic necropsy diagnoses. J Clin Path 2005;58:1261–1264.
7. Roulson J-A, Benbow E, Hasleton PS. Discrepancies between clinical and autopsy diagnosis and the value of post mortem histology; a meta-analysis and review. Histopathology 2005;47:551–559.
8. Zaitoun AM, Fernandez C. The value of histological examination in the audit of hospital autopsies: a quantitative approach. Pathology 1998;30:100–104.
9. Langlois NE. The use of histology in 638 coronial post-mortem examinations of adults: an audit. Med Sci Law 2006;46:310–320.
10. La Grandmaison De GL, Charlier P, Durigon M. Usefulness of Systematic Histological Examination in Routine Forensic Autopsy. J Forensic Sci 2010;55:85–88.
11. Molina DK, Wood LE, Frost RE. Is routine histopathologic examination beneficial in all medicolegal autopsies? Am J Forensic Med Path 2007;28:1.
12. Tse R, Langlois N, Winskog C, et al. An Assessment of the Usefulness of Routine Histological Examination in Hanging Deaths. J Forensic Sci 2012;57:976-8
13. Byard RW, Winskog C. Histology in forensic practice: required or redundant? Forensic Sci Med Pathol 2012:8:56-7.
14. Lau G. Histology in forensic practice. Forensic Sci Med Pathol 2012:8:58-9.
15. Davis GJ. Histology in forensic practice. Forensic Sci Med Pathol 2012;8:60-1.
16. Maeda H. Histology in forensic practice. Forensic Sci Med Pathol 2012;8:62-3.
17. Madea B. Histology in forensic practice. Forensic Sci Med Pathol 2012;8:64-5.
18. Hunsaker JC. Histology in forensic practice. Forensic Sci Med Pathol 2012;8:66-8.
19. Pollanen MS. Histology in forensic practice. Forensic Sci Med Pathol 2012;8:69-70.
20. Cordner S. Histology in forensic practice. Forensic Sci Med Pathol 2012;8:71-2.
21. Human Tissue Act 2004. http://www.legislation.gov.uk/ukpga/2004/30/contents (last visited June 2013)